DATE	DAY	LECTURE	TOPIC/ACTIVITY of Math 142
AUG 30	WEN	1	Introduction to the course. Why differential geometry? Why manifolds? Examples of needs of using geometric methods to extract information from big data including data from physics, economics, politics, culture, and business. Review of Linear Algebra. Least square methods in geometric view.
SEP 4	MON	2	Quadratic surfaces and their relations to the geometry of the set of covariance matrices and SVD/PCA methods. Functional Data and FPCA with applications in big data analytics, especially in economics, politics, culture, and business.
6	WED	3	Definition of Regular Curves, Orientation, and Curves parametrized by Arclength. Dynamical nonlinear big data visualization. Time series. Applications in physics, economics, politics, culture, and business.
11	MON	4	Curvature, Torsion, and Frenet Moving Frames and Formula and local canonical form. Fundamental Theorem of the local theory of curves and applications to finance data.
13	WED	5	Proving Techniques in Diff Geo—using examples. Applications to designing publishable new algorithms of big data analytics.
18	MON	6	Regular Surfaces, Examples, and Properties. Applications to Physics, and big data analytics.
20	WED	7	More on Geometrical modeling with applications. Rigid Motion and Relations with Using Quaternions with Applications in analyzing UAV and finance dynamic data, anomaly detections and data-to-decision.
25	MON	8	Key theorem “Change of Parameters” and introduction to configuration spaces of big data and manifolds.
27	WED	9	Introduction to Statistical Manifold, Lie groups, and homogeneous spaces such as Grassmann manifolds. Finding a Tangent Plane of the Lie group such as SO(3). Applications in Physics, and in big data analytics, especially in economics, politics, culture, and business.

OCT 2	MON	10	The First fundamental forms, Riemannian metrics, and various different non-Euclidean metrics used in big data analytics with applications in economics, politics, culture, and business. Brief introduction of Tensor Analysis.
4	WED	11	The Gauss Map, Second Fundamental Form, Normal curvatures, Principal Curvatures, Mean and Gaussian Curvature and their applications in big data analytics.
9	MON	12	Gauss Map in local Coordinates, Surface of Revolution, Ruled and minimal surfaces. Relations of Hessian and curvatures and their applications in physics and big data analytics.
11	WED	13	Vector fields on manifolds. More on Tensor Analysis. Lie bracket. Reviews for the midterm exam.
16	MON		Fall break.
18	WED		Midterm-Take home-No class.
23	MON	14	Intrinsic Geometry, Isometries, Conforming Maps. Christoffel Symbols. The Gauss Theorem and the equations of compatibility.
25	WED	15	Parallel Transport, Geodesics, and their applications in physics, big data analytics, especially in economics, politics, culture, and business.
30	MON	16	Global Gauss-Bonnet theorem, Exponential Maps and their applications in physics, and big data analytics.
NOV 1	WED	17	INTRODUCTION TO INFORMATION GEOMETRY. Relations between differential geometry, information geometry, big data analytics, and physics. Geometry of Probability of distributions. Challenges in Application of big data analytics in economics, politics, culture, and business.
6	MON	18	The Fisher metric, exponential curved family. Application in big data analytics, especially in economics, politics, culture, and business, part 1.
8	WED	19	Student selected topics in Differential Geometry and Information Geometry. Applications to physics.

			Applications in big data analytics, especially in economics, politics, culture, and business, part 2.
13	MON	20	Student selected topics in Differential Geometry and Information Geometry. Applications to physics. Application in big data analytics, especially in economics, politics, culture, and business, part 3.
15	WED	21	Student selected topics in in Differential Geometry and Information Geometry. Applications to physics. Application in big data analytics, especially in economics, politics, culture, and business, part 4.
20	MON	22	Student selected topics in Information Geometry. Application in big data analytics, especially in economics, politics, culture, and business, part 5.
22	WED	23	Student selected topics in Information Geometry. Application in big data analytics, especially in economics, politics, culture, and business, part 6.
27	MON	24	Student selected topics in Information Geometry. Application in big data analytics, especially in economics, politics, culture, and business, part 7.
29	WED	25	Student selected topics in Information Geometry. Application in big data analytics, especially in economics, politics, culture, and business, part 8.
DEC 4	MON	26	Student selected topics in Information Geometry. Application in big data analytics, especially in economics, politics, culture, and business, part 9.
7	WED	27	Final project presentation—Applications of Differential Geometry to Physics etc.
11	MON	28	Final Project Presentation –Applications of Information Geometry in economics, politics, culture, and business.